

# 16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory

## SST34HF162C / SST34HF164C



Preliminary Specifications

### FEATURES:

- **Flash Organization: 1M x16**
  - 16 Mbit: 12 Mbit + 4 Mbit
- **Concurrent Operation**
  - Read from or Write to SRAM while Erase/Program Flash
- **SRAM Organization:**
  - 2 Mbit: 128K x16
  - 4 Mbit: 256K x16
- **Single 2.7-3.3V Read and Write Operations**
- **Superior Reliability**
  - Endurance: 100,000 Cycles (typical)
  - Greater than 100 years Data Retention
- **Low Power Consumption: (typical values @ 5 MHz)**
  - Active Current: Flash 10 mA (typical)  
SRAM 6 mA (typical)
  - Standby Current: 10  $\mu$ A (typical)
- **Sector-Erase Capability**
  - Uniform 2 KWord sectors
- **Block-Erase Capability**
  - Uniform 32 KWord blocks
- **Read Access Time**
  - Flash: 70 ns
  - SRAM: 70 ns
- **Erase-Suspend / Erase-Resume Capabilities**
- **Latched Address and Data**
- **Fast Erase and Word-Program (typical):**
  - Sector-Erase Time: 18 ms
  - Block-Erase Time: 18 ms
  - Chip-Erase Time: 35 ms
  - Program Time: 7  $\mu$ s
- **Automatic Write Timing**
  - Internal  $V_{PP}$  Generation
- **End-of-Write Detection**
  - Toggle Bit
  - Data# Polling
- **CMOS I/O Compatibility**
- **JEDEC Standard Command Set**
- **Packages Available**
  - 48-ball LBGA (10mm x 12mm)

### PRODUCT DESCRIPTION

The SST34HF162C/164C ComboMemory devices integrate a 1M x16 CMOS flash memory bank with either 128K x16 or 256K x16 CMOS SRAM memory bank in a multi-chip package (MCP). These devices are fabricated using SST's proprietary, high-performance CMOS SuperFlash technology incorporating the split-gate cell design and thick-oxide tunneling injector to attain better reliability and manufacturability compared with alternate approaches. The SST34HF162C/164C devices are ideal for applications such as cellular phones, GPS devices, PDAs, and other portable electronic devices in a low power and small form factor system.

The SuperFlash technology provides fixed Erase and Program times, independent of the number of Erase/Program cycles that have occurred. Therefore, the system software or hardware does not have to be modified or de-rated as is necessary with alternative flash technologies, whose Erase and Program times increase with accumulated Erase/Program cycles. The SST34HF162C/164C devices offer a guaranteed endurance of 10,000 cycles. Data retention is rated at greater than 100 years. With high-performance Program operations, the flash memory banks provide a typical Program time of 7  $\mu$ sec. The entire flash memory bank can be erased and programmed word-by-word in 4 seconds (typically) for the SST34HF162C/164C, when using interface features such as Toggle Bit or Data# Polling

to indicate the completion of Program operation. To protect against inadvertent flash write, the SST34HF162C/164C devices contain on-chip hardware and software data protection schemes.

The flash and SRAM operate as two independent memory banks with respective bank enable signals. The memory bank selection is done by two bank enable signals. The SRAM bank enable signal, BES#, selects the SRAM bank. The flash memory bank enable signal, BEF#, has to be used with Software Data Protection (SDP) command sequence when controlling the Erase and Program operations in the flash memory bank. The memory banks are superimposed in the same memory address space where they share common address lines, data lines, WE# and OE# which minimize power consumption and area. See Figure 1 for memory organization.

Designed, manufactured, and tested for applications requiring low power and small form factor, the SST34HF162C/164C are offered in both commercial and extended temperatures and a small footprint package to meet board space constraint requirements. See Figure 2 for pin assignments.



# 16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory SST34HF162C / SST34HF164C

Preliminary Specifications

## Device Operation

The SST34HF162C/164C use BES# and BEF# to control operation of either the flash or the SRAM memory bank. When BEF# is low, the flash bank is activated for Read, Program or Erase operation. When BES# is low the SRAM is activated for Read and Write operation. BEF# and BES# cannot be at low level at the same time. **If all bank enable signals are asserted, bus contention will result and the device may suffer permanent damage.** All address, data, and control lines are shared by flash and SRAM memory banks which minimizes power consumption and loading. The device goes into standby when BEF# and BES# bank enables are raised to V<sub>IHC</sub> (Logic High) or when BEF# is high.

## Concurrent Read/Write Operation

The SST34HF162C/164C provide the unique benefit of being able to read from or write to SRAM, while simultaneously erasing or programming the flash. This allows data alteration code to be executed from SRAM, while altering the data in flash. The following table lists all valid states.

CONCURRENT READ/WRITE STATE TABLE

Flash	SRAM
Program/Erase	Read
Program/Erase	Write

The device will ignore all SDP commands when an Erase or Program operation is in progress. Note that Product Identification commands use SDP; therefore, these commands will also be ignored while an Erase or Program operation is in progress.

## Flash Read Operation

The Read operation of the SST34HF162C/164C is controlled by BEF# and OE#, both have to be low for the system to obtain data from the outputs. BEF# is used for device selection. When BEF# is high, the chip is deselected and only standby power is consumed. OE# is the output control and is used to gate data from the output pins. The data bus is in high impedance state when either BEF# or OE# is high. Refer to the Read cycle timing diagram for further details (Figure 6).

## Flash Program Operation

These devices are programmed on a word-by-word basis. Before programming, one must ensure that the sector which is being programmed is fully erased.

The Program operation is accomplished in three steps:

1. Software Data Protection is initiated using the three-byte load sequence.
2. Address and data are loaded.

During the Program operation, the addresses are latched on the falling edge of either BEF# or WE#, whichever occurs last. The data is latched on the rising edge of either BEF# or WE#, whichever occurs first.

3. The internal Program operation is initiated after the rising edge of the fourth WE# or BEF#, whichever occurs first. The Program operation, once initiated, will be completed typically within 7  $\mu$ s.

See Figures 7 and 8 for WE# and BEF# controlled Program operation timing diagrams and Figure 18 for flowcharts. During the Program operation, the only valid reads are Data# Polling and Toggle Bit. During the internal Program operation, the host is free to perform additional tasks. Any commands issued during an internal Program operation are ignored.

## Flash Sector- /Block-Erase Operation

These devices offer both Sector-Erase and Block-Erase operations. These operations allow the system to erase the devices on a sector-by-sector (or block-by-block) basis. The sector architecture is based on a uniform sector size of 2 KWord. The Block-Erase mode is based on a uniform block size of 32 KWord. The Sector-Erase operation is initiated by executing a six-byte command sequence with a Sector-Erase command (30H) and sector address (SA) in the last bus cycle. The Block-Erase operation is initiated by executing a six-byte command sequence with Block-Erase command (50H) and block address (BA) in the last bus cycle. The sector or block address is latched on the falling edge of the sixth WE# pulse, while the command (30H or 50H) is latched on the rising edge of the sixth WE# pulse. The internal Erase operation begins after the sixth WE# pulse. Any commands issued during the Block- or Sector-Erase operation are ignored except Erase-Suspend and Erase-Resume. See Figures 12 and 13 for timing waveforms.



# 16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory SST34HF162C / SST34HF164C

Preliminary Specifications

## Flash Chip-Erase Operation

The SST34HF162C/164C provide a Chip-Erase operation, which allows the user to erase all sectors/blocks to the “1” state. This is useful when the device must be quickly erased.

The Chip-Erase operation is initiated by executing a six-byte command sequence with Chip-Erase command (10H) at address 555H in the last byte sequence. The Erase operation begins with the rising edge of the sixth WE# or BEF#, whichever occurs first. During the Erase operation, the only valid read is Toggle Bits or Data# Polling. See Table 5 for the command sequence, Figure 11 for timing diagram, and Figure 21 for the flowchart. Any commands issued during the Chip-Erase operation are ignored.

## Flash Erase-Suspend/-Resume Operations

The Erase-Suspend operation temporarily suspends a Sector- or Block-Erase operation thus allowing data to be read from any memory location, or program data into any sector/block that is not suspended for an Erase operation. The operation is executed by issuing a one-byte command sequence with Erase-Suspend command (B0H). The device automatically enters read mode within 20 μs after the Erase-Suspend command had been issued. Valid data can be read from any sector or block that is not suspended from an Erase operation. Reading at address location within erase-suspended sectors/blocks will output DQ<sub>2</sub> toggling and DQ<sub>6</sub> at “1”. While in Erase-Suspend mode, a Program operation is allowed except for the sector or block selected for Erase-Suspend. To resume Sector-Erase or Block-Erase operation which has been suspended, the system must issue an Erase-Resume command. The operation is executed by issuing a one-byte command sequence with Erase Resume command (30H) at any address in the one-byte sequence.

## Flash Write Operation Status Detection

The SST34HF162C/164C provides two software means to detect the completion of a Write (Program or Erase) cycle, in order to optimize the system Write cycle time. The software detection includes two status bits: Data# Polling (DQ<sub>7</sub>) and Toggle Bit (DQ<sub>6</sub>). The End-of-Write detection mode is enabled after the rising edge of WE#, which initiates the internal Program or Erase operation.

The actual completion of the nonvolatile write is asynchronous with the system; therefore, either a Data# Polling (DQ<sub>7</sub>) or Toggle Bit (DQ<sub>6</sub>) read may be simultaneous with the completion of the Write cycle. If this occurs, the system may possibly get an erroneous result, i.e., valid data may appear to conflict with either DQ<sub>7</sub> or DQ<sub>6</sub>. In order to pre-

vent spurious rejection, if an erroneous result occurs, the software routine should include a loop to read the accessed location an additional two (2) times. If both reads are valid, then the device has completed the Write cycle, otherwise the rejection is valid.

## Flash Data# Polling (DQ<sub>7</sub>)

When the device is in an internal Program operation, any attempt to read DQ<sub>7</sub> will produce the complement of the true data. Once the Program operation is completed, DQ<sub>7</sub> will produce true data. During internal Erase operation, any attempt to read DQ<sub>7</sub> will produce a ‘0’. Once the internal Erase operation is completed, DQ<sub>7</sub> will produce a ‘1’. The Data# Polling is valid after the rising edge of fourth WE# (or BEF#) pulse for Program operation. For Sector-, Block-, or Chip-Erase, the Data# Polling is valid after the rising edge of sixth WE# (or BEF#) pulse. See Figure 9 for Data# Polling (DQ<sub>7</sub>) timing diagram and Figure 19 for a flowchart.

## Toggle Bits (DQ<sub>6</sub> and DQ<sub>2</sub>)

During the internal Program or Erase operation, any consecutive attempts to read DQ<sub>6</sub> will produce alternating “1”s and “0”s, i.e., toggling between 1 and 0. When the internal Program or Erase operation is completed, the DQ<sub>6</sub> bit will stop toggling. The device is then ready for the next operation. The toggle bit is valid after the rising edge of the fourth WE# (or BEF#) pulse for Program operations. For Sector-, Block-, or Chip-Erase, the toggle bit (DQ<sub>6</sub>) is valid after the rising edge of sixth WE# (or BEF#) pulse. DQ<sub>6</sub> will be set to “1” if a Read operation is attempted on an Erase-suspended Sector/Block. If Program operation is initiated in a sector/block not selected in Erase-Suspend mode, DQ<sub>6</sub> will toggle.

An additional Toggle Bit is available on DQ<sub>2</sub>, which can be used in conjunction with DQ<sub>6</sub> to check whether a particular sector is being actively erased or erase-suspended. Table 1 shows detailed status bit information. The Toggle Bit (DQ<sub>2</sub>) is valid after the rising edge of the last WE# (or BEF#) pulse of a Write operation. See Figure 10 for Toggle Bit timing diagram and Figure 19 for a flowchart.

**TABLE 1: WRITE OPERATION STATUS**

Status		DQ <sub>7</sub>	DQ <sub>6</sub>	DQ <sub>2</sub>
Normal Operation	Standard Program	DQ7#	Toggle	No Toggle
	Standard Erase	0	Toggle	Toggle



# 16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory SST34HF162C / SST34HF164C

Preliminary Specifications

**TABLE 1: WRITE OPERATION STATUS**

Status		DQ <sub>7</sub>	DQ <sub>6</sub>	DQ <sub>2</sub>
Erase-Suspend Mode	Read From Erase Suspended Sector/Block	1	1	Toggle
	Read From Non-Erase Suspended Sector/Block	Data	Data	Data
	Program	DQ7#	Toggle	No Toggle

T1.0 1269

**Note:** DQ<sub>7</sub>, DQ<sub>6</sub>, and DQ<sub>2</sub> require a valid address when reading status information.

## Data Protection

The SST34HF162C/164C provide both hardware and software features to protect nonvolatile data from inadvertent writes.

### Hardware Data Protection

**Noise/Glitch Protection:** A WE# or BEF# pulse of less than 5 ns will not initiate a Write cycle.

**V<sub>DD</sub> Power Up/Down Detection:** The Write operation is inhibited when V<sub>DD</sub> is less than 1.5V.

**Write Inhibit Mode:** Forcing OE# low, BEF# high, or WE# high will inhibit the Write operation. This prevents inadvertent writes during power-up or power-down.

### Software Data Protection (SDP)

The SST34HF162C/164C provide the JEDEC standard Software Data Protection scheme for all data alteration operations, i.e., Program and Erase. Any Program operation requires the inclusion of the three-byte sequence. The three-byte load sequence is used to initiate the Program operation, providing optimal protection from inadvertent Write operations, e.g., during the system power-up or power-down. Any Erase operation requires the inclusion of six-byte sequence. The SST34HF162C/164C are shipped with the Software Data Protection permanently enabled. See Table 5 for the specific software command codes. During SDP command sequence, invalid commands will abort the device to Read mode within T<sub>RC</sub>. The contents of DQ<sub>15</sub>-DQ<sub>8</sub> are "Don't Care" during any SDP command sequence.

## Product Identification

The Product Identification mode identifies the device as SST34HF162C or SST34HF164C and the manufacturer as SST. This mode may be accessed by software operations only. The hardware device ID Read operation, which is typically used by programmers cannot be used on this device because of the shared lines between flash and SRAM in the multi-chip package. Therefore, application of high voltage to pin A<sub>9</sub> may damage this device. Users may use the software Product Identification operation to identify the part (i.e., using the device ID) when using multiple manufacturers in the same socket. For details, see Tables 4 and 5 for software operation, Figure 14 for the Software ID Entry and Read timing diagram and Figure 20 for the ID Entry command sequence flowchart.

**TABLE 2: PRODUCT IDENTIFICATION**

	ADDRESS	DATA
Manufacturer's ID	BK0000H	00BFH
Device ID SST34HF162C/164C	BK0001H	734BH

T2.1 1269

**Note:** BK = Bank Address (A<sub>19</sub>-A<sub>18</sub>)

### Product Identification Mode Exit

In order to return to the standard Read mode, the Software Product Identification mode must be exited. Exit is accomplished by issuing the Software ID Exit command sequence, which returns the device to the Read mode. This command may also be used to reset the device to the Read mode after any inadvertent transient condition that apparently causes the device to behave abnormally, e.g., not read correctly. Please note that the Software ID Exit command is ignored during an internal Program or Erase operation. See Table 5 for software command codes, Figure 15 for timing waveform and Figure 20 for a flowchart.



# 16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory

## SST34HF162C / SST34HF164C

Preliminary Specifications

### SRAM Operation

With BES# low and BEF# high, the SST34HF162C/164C operate as either 128K x16 or 256K x16 CMOS SRAM, with fully static operation requiring no external clocks or timing strobes. The SST34HF162C/164C SRAM is mapped into the first 128 KWord address space. When BES# and BEF# are high, all memory banks are deselected and the device enters standby. Read and Write cycle times are equal. The control signals UBS# and LBS# provide access to the upper data byte and lower data byte. See Table 4 for SRAM Read and Write data byte control modes of operation.

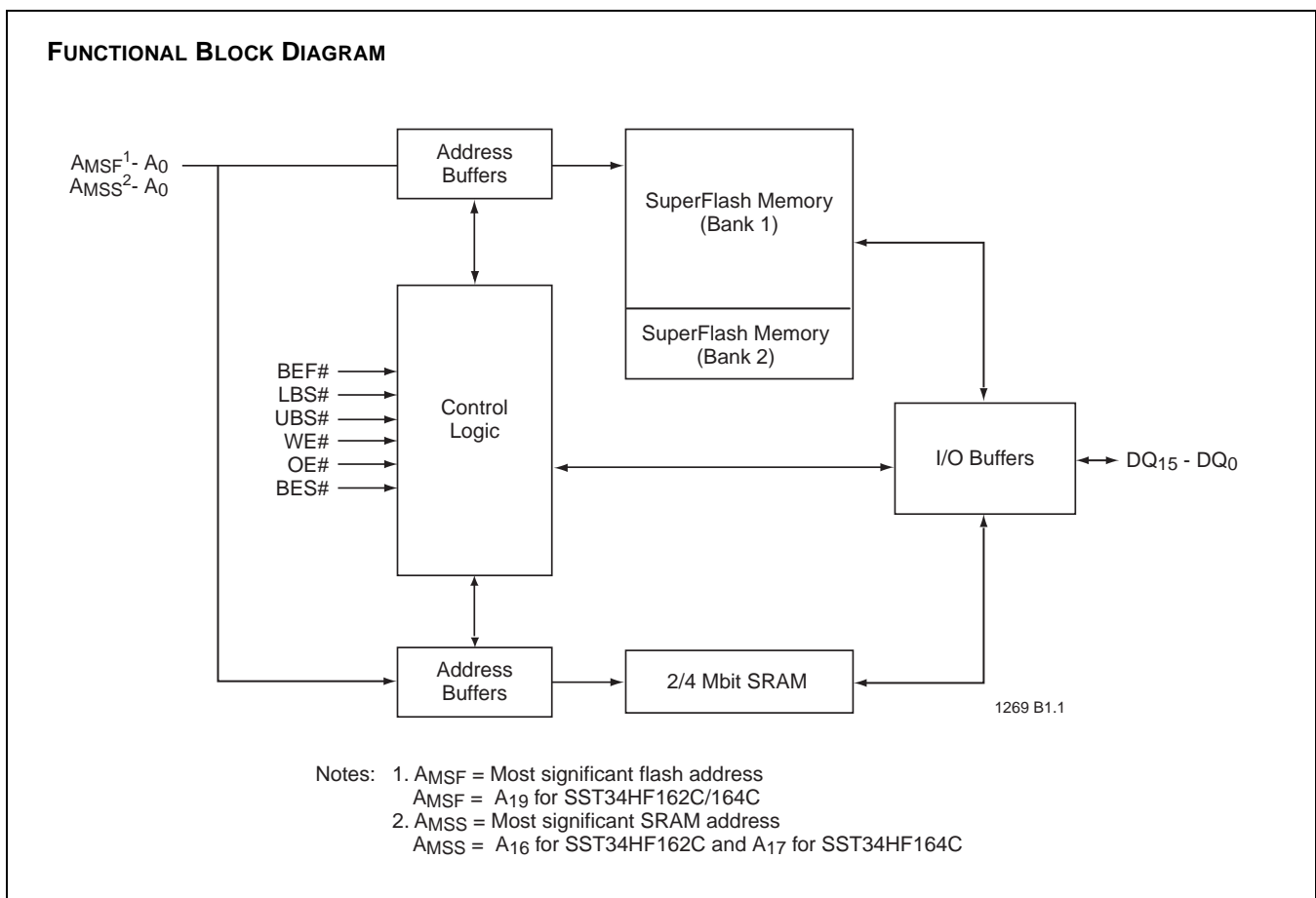
### SRAM Read

The SRAM Read operation of the SST34HF162C/164C is controlled by OE# and BES#, both have to be low with WE# high for the system to obtain data from the outputs.

BES# is used for SRAM bank selection. OE# is the output control and is used to gate data from the output pins. The data bus is in high impedance state when OE# is high. Refer to the Read cycle timing diagram, Figure 3, for further details.

### SRAM Write

The SRAM Write operation of the SST34HF162C/164C is controlled by WE# and BES#, both have to be low for the system to write to the SRAM. During the Word-Write operation, the addresses and data are referenced to the rising edge of either BES# or WE# whichever occurs first. The write time is measured from the last falling edge of BES# or WE# to the first rising edge of BES# or WE#. Refer to the Write cycle timing diagrams, Figures 4 and 5, for further details.





# 16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory SST34HF162C / SST34HF164C

Preliminary Specifications

32 KWord Blocks; 2 KWord Sectors

FFFFFH F8000H	Block 31	Bank 2
F7FFFH F0000H	Block 30	
EFFFFH E8000H	Block 29	
E7FFFH E0000H	Block 28	
DFFFFH D8000H	Block 27	
D7FFFH D0000H	Block 26	
CFFFFH C8000H	Block 25	
C7FFFH C0000H	Block 24	
BFFFFH B8000H	Block 23	Bank 1
B7FFFH B0000H	Block 22	
AFFFFH A8000H	Block 21	
A7FFFH A0000H	Block 20	
9FFFFH 98000H	Block 19	
97FFFH 90000H	Block 18	
8FFFFH 88000H	Block 17	
87FFFH 80000H	Block 16	
7FFFFH 78000H	Block 15	
77FFFH 70000H	Block 14	
6FFFFH 68000H	Block 13	
67FFFH 60000H	Block 12	
5FFFFH 58000H	Block 11	
57FFFH 50000H	Block 10	
4FFFFH 48000H	Block 9	
47FFFH 40000H	Block 8	
3FFFFH 38000H	Block 7	
37FFFH 30000H	Block 6	
2FFFFH 28000H	Block 5	
27FFFH 20000H	Block 4	
1FFFFH 18000H	Block 3	
17FFFH 10000H	Block 2	
0FFFFH 08000H	Block 1	
07FFFH 02000H	Block 0	
01FFFH 00000H		

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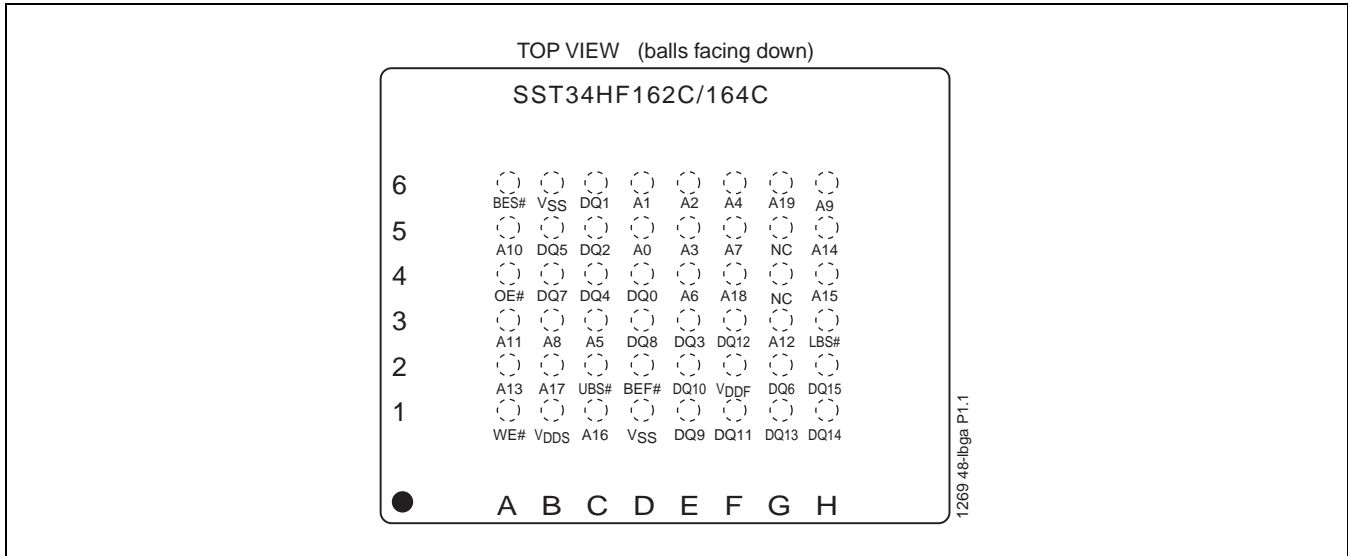
**FIGURE 1: DUAL-BANK MEMORY ORGANIZATION**

# 16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory

## SST34HF162C / SST34HF164C



Preliminary Specifications



**FIGURE 2: PIN ASSIGNMENTS FOR 48-BALL LBGA (10MM X 12MM)**

**TABLE 3: PIN DESCRIPTION**

Symbol	Pin Name	Functions
A <sub>MSS</sub> <sup>1</sup> to A <sub>0</sub>	Address Inputs	To provide flash address, A <sub>19</sub> -A <sub>0</sub> . To provide SRAM address, A <sub>MSS</sub> -A <sub>0</sub>
DQ <sub>15</sub> -DQ <sub>0</sub>	Data Inputs/Outputs	To output data during Read cycles and receive input data during Write cycles. Data is internally latched during a flash Erase/Program cycle. The outputs are in tri-state when OE#, BES#, and BEF# are high.
BEF#	Flash Memory Bank Enable	To activate the Flash memory bank when BEF# is low
BES#	SRAM Memory Bank Enable	To activate the SRAM memory bank when BES# is low
OE#	Output Enable	To gate the data output buffers
WE#	Write Enable	To control the Write operations
UBS#	Upper Byte Control (SRAM)	To enable DQ <sub>15</sub> -DQ <sub>8</sub>
LBS#	Lower Byte Control (SRAM)	To enable DQ <sub>7</sub> -DQ <sub>0</sub>
V <sub>SS</sub>	Ground	
V <sub>DDF</sub>	Power Supply (Flash)	2.7-3.3V Power Supply to Flash only
V <sub>DD5</sub>	Power Supply (SRAM)	2.7-3.3V Power Supply to SRAM only
NC	No Connection	Unconnected pins

T3.1 1269

1. A<sub>MS</sub> = Most Significant Address  
A<sub>MS</sub> = A<sub>16</sub> for SST34HF162C and A<sub>17</sub> for SST34HF164C



# 16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory SST34HF162C / SST34HF164C

Preliminary Specifications

**TABLE 4: OPERATIONAL MODES SELECTION FOR SRAM**

Mode	BEF# <sup>1</sup>	BES# <sup>1,2</sup>	OE# <sup>2</sup>	WE# <sup>2</sup>	LBS# <sup>2</sup>	UBS# <sup>2</sup>	DQ <sub>15-0</sub>	DQ <sub>15-8</sub>	
Full Standby	V <sub>IH</sub>	V <sub>IH</sub>	X	X	X	X	HIGH-Z	HIGH-Z	HIGH-Z
		X	X	X	X	X			
Output Disable	V <sub>IH</sub>	V <sub>IL</sub>	V <sub>IH</sub>	V <sub>IH</sub>	X	X	HIGH-Z	HIGH-Z	HIGH-Z
		V <sub>IL</sub>	X	X	V <sub>IH</sub>	V <sub>IH</sub>			
	V <sub>IL</sub>	V <sub>IH</sub>	V <sub>IH</sub>	V <sub>IH</sub>	X	X	HIGH-Z	HIGH-Z	HIGH-Z
Flash Read	V <sub>IL</sub>	V <sub>IH</sub>	V <sub>IL</sub>	V <sub>IH</sub>	X	X	D <sub>OUT</sub>	D <sub>OUT</sub>	DQ <sub>15-8</sub> =HIGH-Z
		X							
Flash Write	V <sub>IL</sub>	V <sub>IH</sub>	V <sub>IH</sub>	V <sub>IL</sub>	X	X	D <sub>IN</sub>	D <sub>IN</sub>	DQ <sub>15-8</sub> =HIGH-Z
		X							
Flash Erase	V <sub>IL</sub>	V <sub>IH</sub>	V <sub>IH</sub>	V <sub>IL</sub>	X	X	X	X	X
		X							
SRAM Read	V <sub>IH</sub>	V <sub>IL</sub>	V <sub>IL</sub>	V <sub>IH</sub>	V <sub>IL</sub>	V <sub>IL</sub>	D <sub>OUT</sub>	D <sub>OUT</sub>	D <sub>OUT</sub>
					V <sub>IH</sub>	V <sub>IL</sub>	HIGH-Z	D <sub>OUT</sub>	D <sub>OUT</sub>
					V <sub>IL</sub>	V <sub>IH</sub>	D <sub>OUT</sub>	HIGH-Z	HIGH-Z
SRAM Write	V <sub>IH</sub>	V <sub>IL</sub>	X	V <sub>IL</sub>	V <sub>IL</sub>	V <sub>IL</sub>	D <sub>IN</sub>	D <sub>IN</sub>	D <sub>IN</sub>
					V <sub>IH</sub>	V <sub>IL</sub>	HIGH-Z	D <sub>IN</sub>	D <sub>IN</sub>
					V <sub>IL</sub>	V <sub>IH</sub>	D <sub>IN</sub>	HIGH-Z	HIGH-Z
Product Identification <sup>3</sup>	V <sub>IL</sub>	V <sub>IH</sub>	V <sub>IL</sub>	V <sub>IH</sub>	X	X	Manufacturer's ID <sup>4</sup> Device ID <sup>4</sup>		

T4.1 1269

1. Do not apply BEF# = V<sub>IL</sub> and BES# = V<sub>IL</sub> at the same time
2. X can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value.
3. Software mode only
4. With A<sub>19</sub>-A<sub>18</sub> = V<sub>IL</sub>, SST Manufacturer's ID = BFH, is read with A<sub>0</sub>=0,  
SST34HF162C/164C Device ID = 734BH, is read with A<sub>0</sub>=1





# 16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory

## SST34HF162C / SST34HF164C

Preliminary Specifications

**TABLE 5: SOFTWARE COMMAND SEQUENCE**

Command Sequence	1st Bus Write Cycle		2nd Bus Write Cycle		3rd Bus Write Cycle		4th Bus Write Cycle		5th Bus Write Cycle		6th Bus Write Cycle	
	Addr <sup>1</sup>	Data <sup>2</sup>	Addr <sup>1</sup>	Data <sup>2</sup>	Addr <sup>1</sup>	Data <sup>2</sup>	Addr <sup>1</sup>	Data <sup>2</sup>	Addr <sup>1</sup>	Data <sup>2</sup>	Addr <sup>1</sup>	Data <sup>2</sup>
Program	555H	AAH	2AAH	55H	555H	A0H	WA <sup>3</sup>	Data				
Sector-Erase	555H	AAH	2AAH	55H	555H	80H	555H	AAH	2AAH	55H	SA <sub>X</sub> <sup>4</sup>	30H
Block-Erase	555H	AAH	2AAH	55H	555H	80H	555H	AAH	2AAH	55H	BA <sub>X</sub> <sup>4</sup>	50H
Chip-Erase	555H	AAH	2AAH	55H	555H	80H	555H	AAH	2AAH	55H	555H	10H
Erase-Suspend	XXXXH	B0H										
Erase-Resume	XXXXH	30H										
Software ID Entry <sup>5</sup>	555H	AAH	2AAH	55H	BK <sub>X</sub> <sup>6</sup> 555H	90H						
Software ID Exit	555H	AAH	2AAH	55H	555H	F0H						
Software ID Exit	XXH	F0H										

T5.0 1269

1. Address format A<sub>11</sub>.A<sub>0</sub> (Hex), Addresses A<sub>19</sub>-A<sub>12</sub> can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value, for the command sequence.
2. DQ<sub>15</sub>-DQ<sub>8</sub> can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value, for the command sequence
3. WA = Program word address
4. SA<sub>X</sub> for Sector-Erase; uses A<sub>19</sub>-A<sub>10</sub> address lines  
BA<sub>X</sub> for Block-Erase; uses A<sub>19</sub>-A<sub>15</sub> address lines
5. The device does not remain in Software Product Identification mode if powered down.
6. A<sub>19</sub> and A<sub>18</sub> = V<sub>IL</sub>

**Absolute Maximum Stress Ratings** (Applied conditions greater than those listed under “Absolute Maximum Stress Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these conditions or conditions greater than those defined in the operational sections of this data sheet is not implied. Exposure to absolute maximum stress rating conditions may affect device reliability.)

Operating Temperature . . . . . -20°C to +85°C  
 Storage Temperature . . . . . -65°C to +125°C  
 D. C. Voltage on Any Pin to Ground Potential . . . . . -0.5V to V<sub>DD</sub><sup>1</sup>+0.3V  
 Transient Voltage (<20 ns) on Any Pin to Ground Potential . . . . . -1.0V to V<sub>DD</sub><sup>1</sup>+1.0V  
 Package Power Dissipation Capability (Ta = 25°C) . . . . . 1.0W  
 Output Short Circuit Current<sup>2</sup>. . . . . 50 mA

1. V<sub>DD</sub> = V<sub>DDF</sub> and V<sub>DDS</sub>
2. Outputs shorted for no more than one second. No more than one output shorted at a time.

### OPERATING RANGE

Range	Ambient Temp	V <sub>DD</sub>
Commercial	0°C to +70°C	2.7-3.3V
Extended	-20°C to +85°C	2.7-3.3V

### AC CONDITIONS OF TEST

Input Rise/Fall Time . . . . .	5 ns
Output Load . . . . .	C <sub>L</sub> = 30 pF
See Figures 16 and 17	



# 16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory SST34HF162C / SST34HF164C

Preliminary Specifications

**TABLE 6: DC OPERATING CHARACTERISTICS ( $V_{DD} = V_{DDF}$  AND  $V_{DDs} = 2.7-3.3V$ )**

Symbol	Parameter	Limits			Test Conditions
		Min	Max	Units	
$I_{DD}^1$	Active $V_{DD}$ Current				Address input = $V_{ILT}/V_{IHT}$ , at f=5 MHz, $V_{DD}=V_{DD}$ Max, all DQs open OE#= $V_{IL}$ , WE#= $V_{IH}$ BEF#= $V_{IL}$ , BES#= $V_{IH}$ BEF#= $V_{IH}$ , BES#= $V_{IL}$
	Read				
	Flash		15	mA	
	SRAM		10	mA	
	Concurrent Operation		45	mA	BEF#= $V_{IH}$ , BES#= $V_{IL}$
	Write <sup>2</sup>				WE#= $V_{IL}$
	Flash		40	mA	BEF#= $V_{IL}$ , BES#= $V_{IH}$ , OE#= $V_{IH}$
	SRAM		30	mA	BEF#= $V_{IH}$ , BES#= $V_{IL}$
$I_{SB}$	Standby $V_{DD}$ Current		30	$\mu A$	$V_{DD} = V_{DD}$ Max, BEF#=BES#= $V_{IHC}$
$I_{LI}$	Input Leakage Current		1	$\mu A$	$V_{IN}=GND$ to $V_{DD}$ , $V_{DD}=V_{DD}$ Max
$I_{LO}$	Output Leakage Current		10	$\mu A$	$V_{OUT}=GND$ to $V_{DD}$ , $V_{DD}=V_{DD}$ Max
$V_{IL}$	Input Low Voltage		0.8	V	$V_{DD}=V_{DD}$ Min
$V_{ILC}$	Input Low Voltage (CMOS)		0.3	V	$V_{DD}=V_{DD}$ Max
$V_{IH}$	Input High Voltage	0.7 $V_{DD}$		V	$V_{DD}=V_{DD}$ Max
$V_{IHC}$	Input High Voltage (CMOS)	$V_{DD}-0.3$		V	$V_{DD}=V_{DD}$ Max
$V_{OLF}$	Flash Output Low Voltage		0.2	V	$I_{OL}=100 \mu A$ , $V_{DD}=V_{DD}$ Min
$V_{OHF}$	Flash Output High Voltage	$V_{DD}-0.2$		V	$I_{OH}=-100 \mu A$ , $V_{DD}=V_{DD}$ Min
$V_{OLS}$	SRAM Output Low Voltage		0.4	V	$I_{OL} = 1$ mA, $V_{DD}=V_{DD}$ Min
$V_{OHS}$	SRAM Output High Voltage	2.2		V	$I_{OH} = -500 \mu A$ , $V_{DD}=V_{DD}$ Min

T6.1 1269

1. See Figure 16
2.  $I_{DD}$  active while Erase or Program is in progress.

**TABLE 7: RECOMMENDED SYSTEM POWER-UP TIMINGS**

Symbol	Parameter	Minimum	Units
$T_{PU-READ}^1$	Power-up to Read Operation	100	$\mu s$
$T_{PU-WRITE}^1$	Power-up to Write Operation	100	$\mu s$

T7.0 1269

1. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.

**TABLE 8: CAPACITANCE ( $T_a = 25^\circ C$ , f=1 Mhz, other pins open)**

Parameter	Description	Test Condition	Maximum
$C_{I/O}^1$	I/O Pin Capacitance	$V_{I/O} = 0V$	20 pF
$C_{IN}^1$	Input Capacitance	$V_{IN} = 0V$	16 pF

T8.0 1269

1. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.

**TABLE 9: FLASH RELIABILITY CHARACTERISTICS**

Symbol	Parameter	Minimum Specification	Units	Test Method
$N_{END}^1$	Endurance	10,000	Cycles	JEDEC Standard A117
$T_{DR}^1$	Data Retention	100	Years	JEDEC Standard A103
$I_{LTH}^1$	Latch Up	$100 + I_{DD}$	mA	JEDEC Standard 78

T9.0 1269

1. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.



**AC CHARACTERISTICS**

**TABLE 10: SRAM READ CYCLE TIMING PARAMETERS**

Symbol	Parameter	Min	Max	Units
T <sub>RCS</sub>	Read Cycle Time	70		ns
T <sub>AAS</sub>	Address Access Time		70	ns
T <sub>BES</sub>	Bank Enable Access Time		70	ns
T <sub>OES</sub>	Output Enable Access Time		35	ns
T <sub>BYES</sub>	UBS#, LBS# Access Time		70	ns
T <sub>BLZS</sub> <sup>1</sup>	BES# to Active Output	0		ns
T <sub>OLZS</sub> <sup>1</sup>	Output Enable to Active Output	0		ns
T <sub>BYLZS</sub> <sup>1</sup>	UBS#, LBS# to Active Output	0		ns
T <sub>BHZS</sub> <sup>1</sup>	BES# to High-Z Output		25	ns
T <sub>OHS</sub> <sup>1</sup>	Output Disable to High-Z Output		25	ns
T <sub>BYHS</sub> <sup>1</sup>	UBS#, LBS# to High-Z Output		35	ns
T <sub>OHS</sub>	Output Hold from Address Change	10		ns

T10.0 1269

1. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.

**TABLE 11: SRAM WRITE CYCLE TIMING PARAMETERS**

Symbol	Parameter	Min	Max	Units
T <sub>WCS</sub>	Write Cycle Time	70		ns
T <sub>BWS</sub>	Bank Enable to End-of-Write	60		ns
T <sub>AWS</sub>	Address Valid to End-of-Write	60		ns
T <sub>ASTS</sub>	Address Set-up Time	0		ns
T <sub>WPS</sub>	Write Pulse Width	60		ns
T <sub>WRS</sub>	Write Recovery Time	0		ns
T <sub>BYWS</sub>	UBS#, LBS# to End-of-Write	60		ns
T <sub>ODWS</sub>	Output Disable from WE# Low		30	ns
T <sub>OEWS</sub>	Output Enable from WE# High	0		ns
T <sub>DSS</sub>	Data Set-up Time	30		ns
T <sub>DHS</sub>	Data Hold from Write Time	0		ns

T11.0 1269



# 16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory SST34HF162C / SST34HF164C

Preliminary Specifications

**TABLE 12: FLASH READ CYCLE TIMING PARAMETERS  $V_{DD} = 2.7-3.3V$**

Symbol	Parameter	Min	Max	Units
$T_{RC}$	Read Cycle Time	70		ns
$T_{CE}$	Chip Enable Access Time		70	ns
$T_{AA}$	Address Access Time		70	ns
$T_{OE}$	Output Enable Access Time		35	ns
$T_{CLZ}^1$	BEF# Low to Active Output	0		ns
$T_{OLZ}^1$	OE# Low to Active Output	0		ns
$T_{CHZ}^1$	BEF# High to High-Z Output		20	ns
$T_{OHZ}^1$	OE# High to High-Z Output		20	ns
$T_{OH}^1$	Output Hold from Address Change	0		ns

T12.0 1269

1. This parameter is measured only for initial qualification and after the design or process change that could affect this parameter.

**TABLE 13: FLASH PROGRAM/ERASE CYCLE TIMING PARAMETERS**

Symbol	Parameter	Min	Max	Units
$T_{BP}$	Program Time		12	$\mu s$
$T_{AS}$	Address Setup Time	0		ns
$T_{AH}$	Address Hold Time	40		ns
$T_{CS}$	WE# and BEF# Setup Time	0		ns
$T_{CH}$	WE# and BEF# Hold Time	0		ns
$T_{OES}$	OE# High Setup Time	0		ns
$T_{OEH}$	OE# High Hold Time	10		ns
$T_{CP}$	BEF# Pulse Width	40		ns
$T_{WP}$	WE# Pulse Width	40		ns
$T_{WPH}^1$	WE# Pulse Width High	30		ns
$T_{CPH}^1$	BEF# Pulse Width High	30		ns
$T_{DS}$	Data Setup Time	30		ns
$T_{DH}^1$	Data Hold Time	0		ns
$T_{IDA}^1$	Software ID Access and Exit Time		150	ns
$T_{ES}$	Erase-Suspend Latency		20	$\mu s$
$T_{BR}^1$	Bus# Recovery Time		1	$\mu s$
$T_{SE}$	Sector-Erase		25	ms
$T_{BE}$	Block-Erase		25	ms
$T_{SCE}$	Chip-Erase		50	ms

T13.1 1269

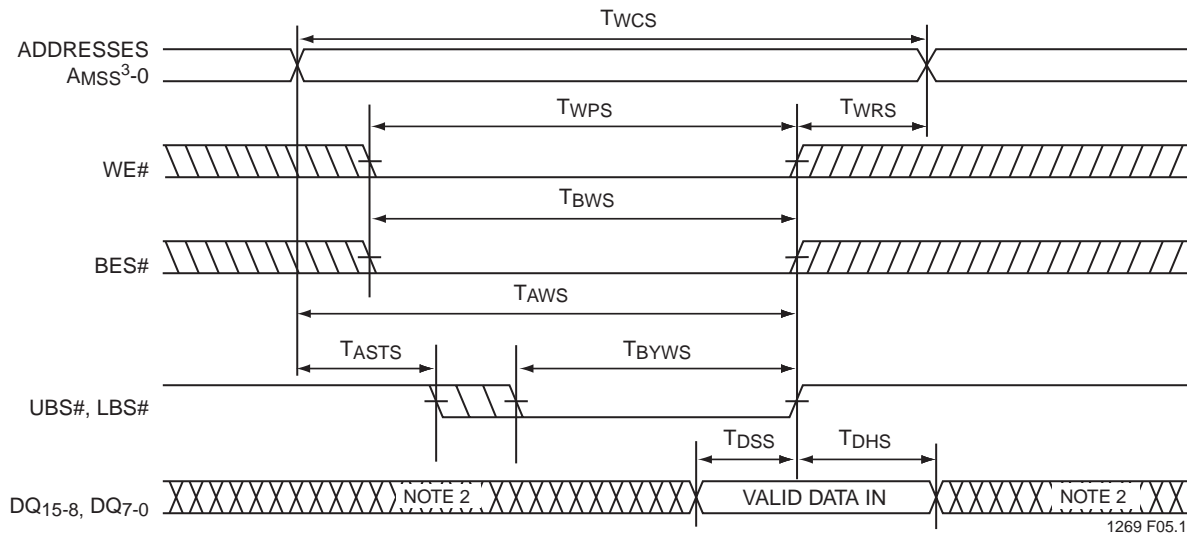
1. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.





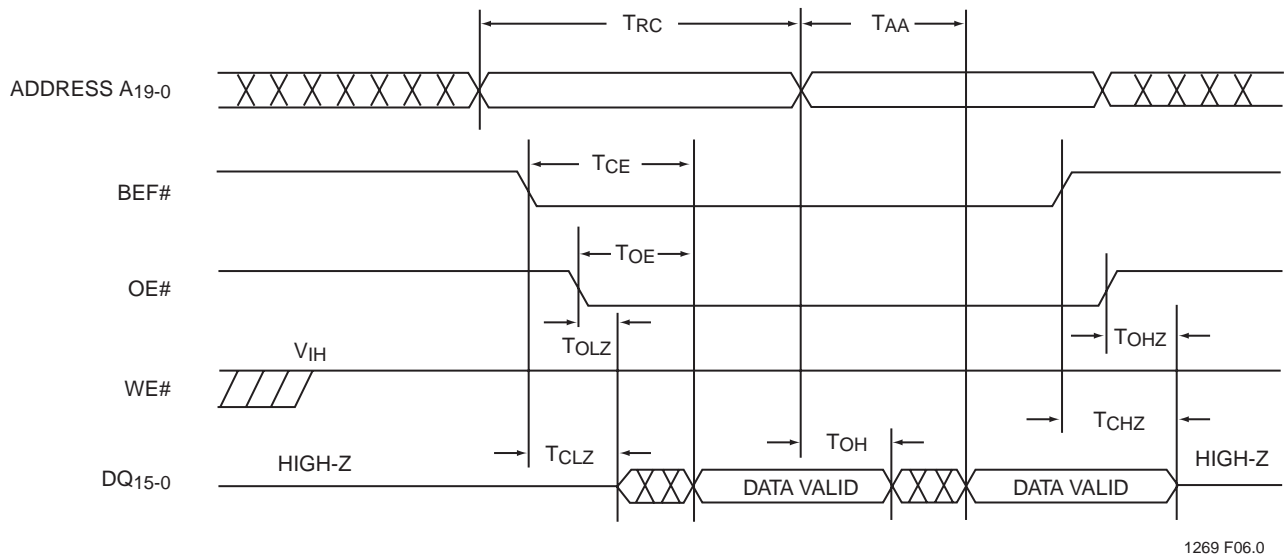
# 16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory SST34HF162C / SST34HF164C

Preliminary Specifications



- Note:**
1. If OE# is High during the Write cycle, the outputs will remain at high impedance.
  2. Because D<sub>IN</sub> signals may be in the output state at this time, input signals of reverse polarity must not be applied.
  3. A<sub>MSS</sub> = Most Significant SRAM Address  
A<sub>MSS</sub> = A<sub>16</sub> for SST34HF162C and A<sub>17</sub> for SST34HF164C

**FIGURE 5: SRAM WRITE CYCLE TIMING DIAGRAM (UBS#, LBS# CONTROLLED)<sup>1</sup>**



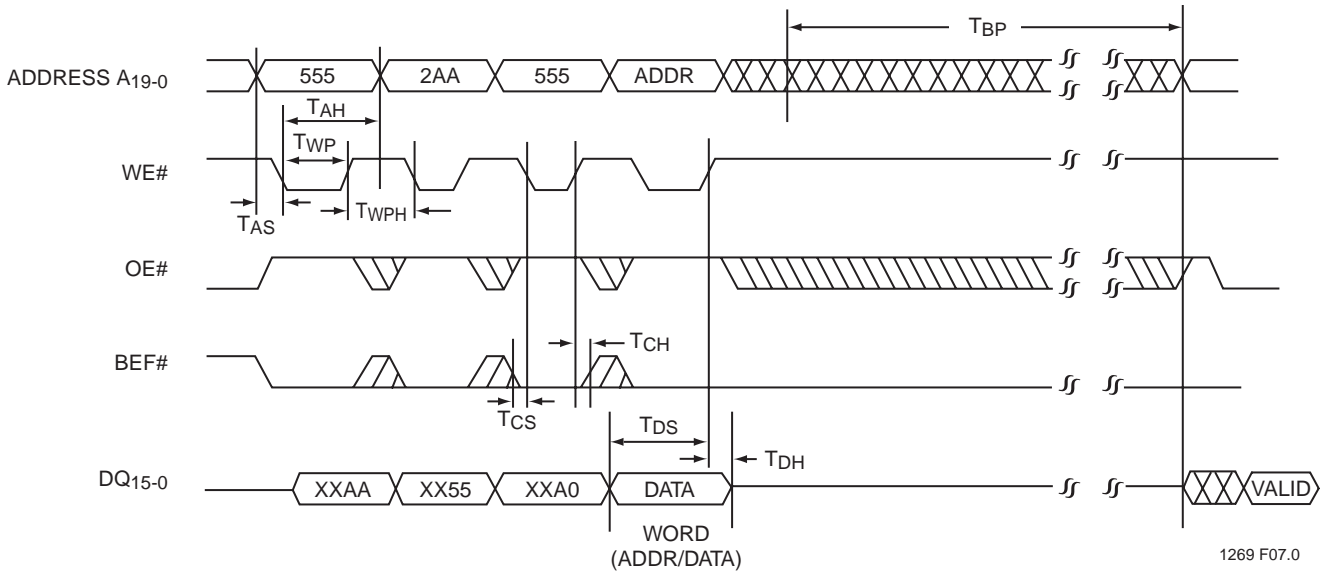
**FIGURE 6: FLASH READ CYCLE TIMING DIAGRAM**

# 16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory

## SST34HF162C / SST34HF164C

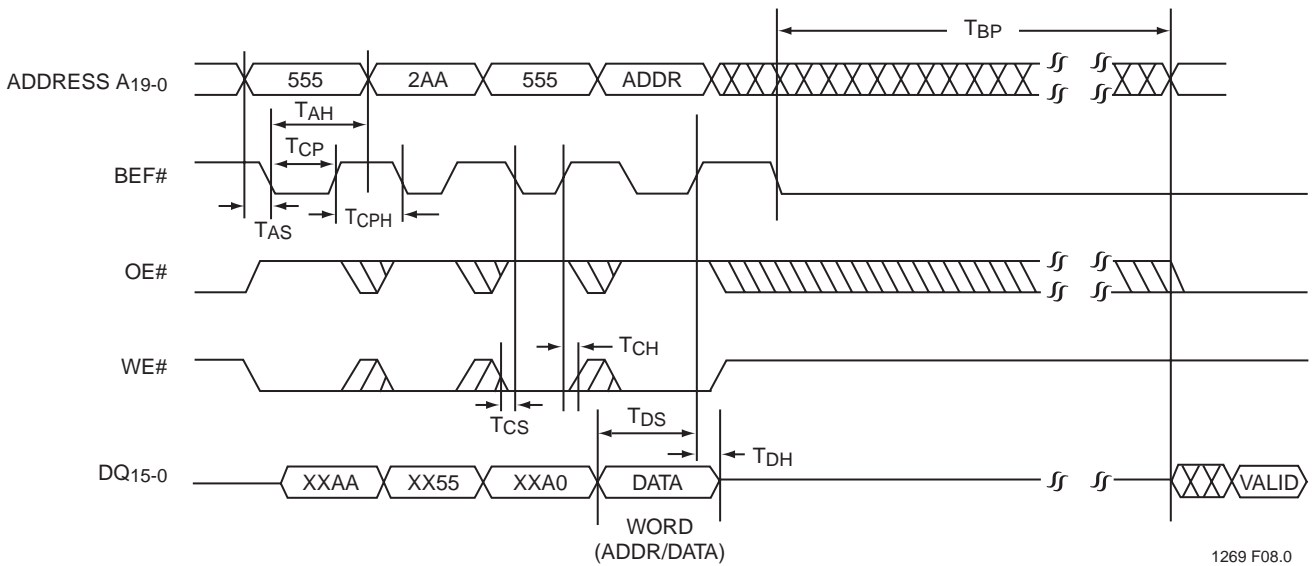


Preliminary Specifications



Note: X can be  $V_{IL}$  or  $V_{IH}$ , but no other value.

**FIGURE 7: FLASH WE# CONTROLLED PROGRAM CYCLE TIMING DIAGRAM**



Note: X can be  $V_{IL}$  or  $V_{IH}$ , but no other value.

**FIGURE 8: FLASH BEF# CONTROLLED PROGRAM CYCLE TIMING DIAGRAM**



# 16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory SST34HF162C / SST34HF164C

Preliminary Specifications

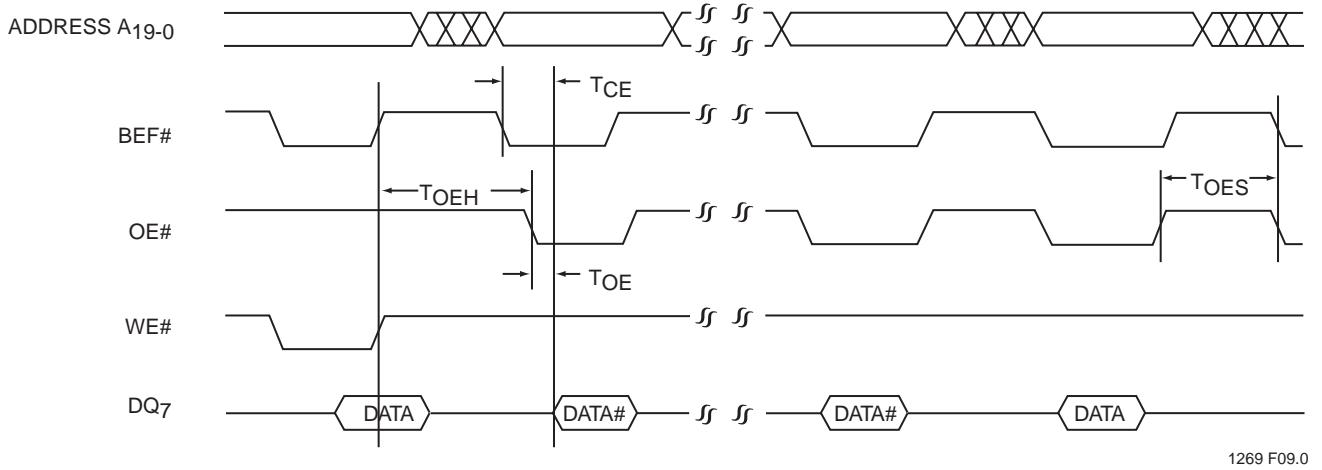


FIGURE 9: FLASH DATA# POLLING TIMING DIAGRAM

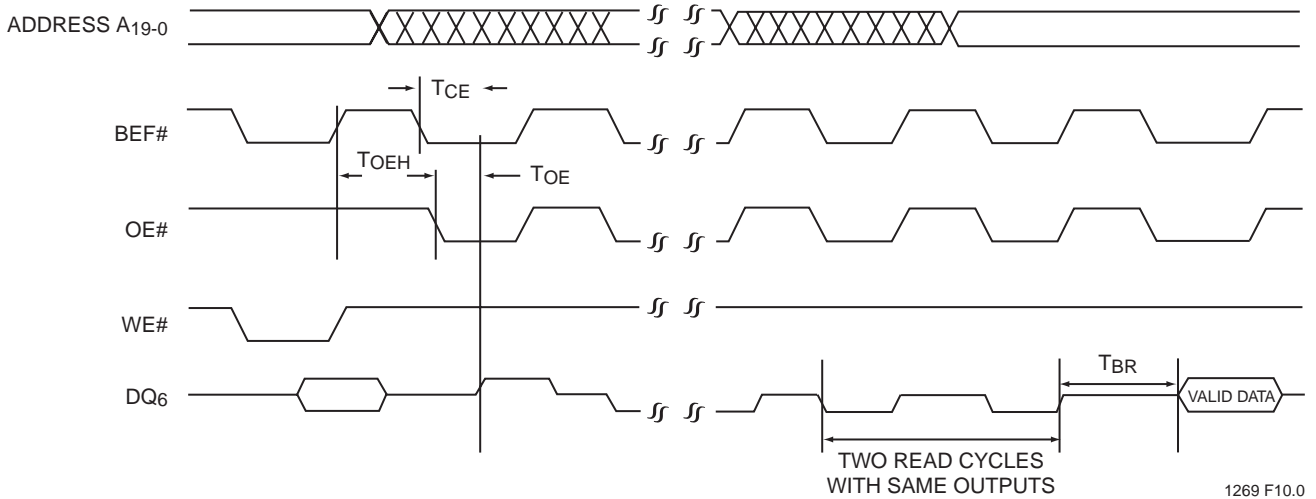
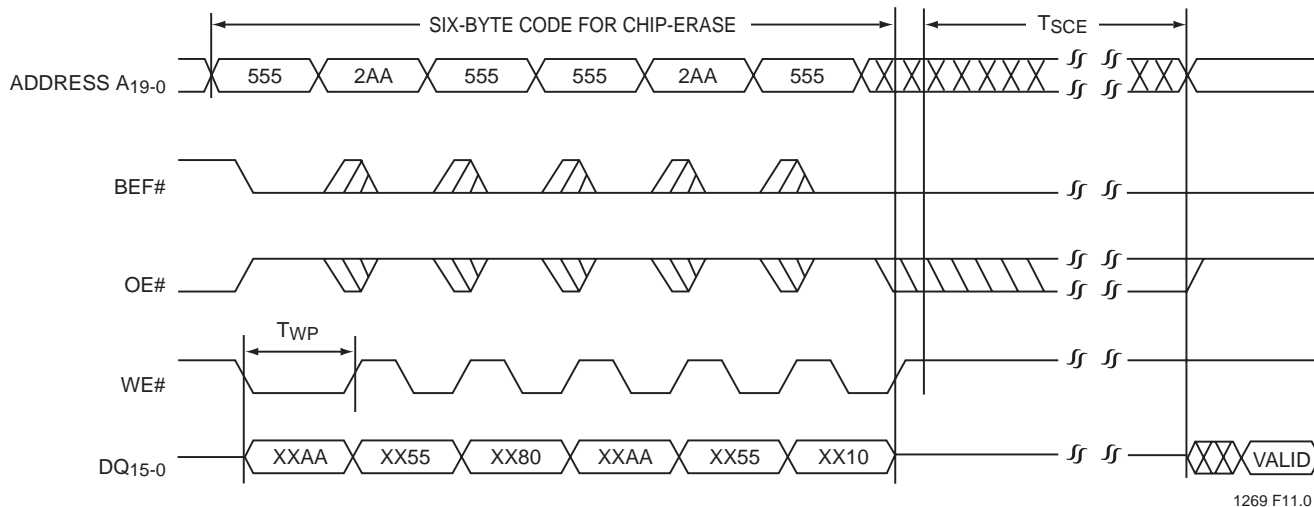


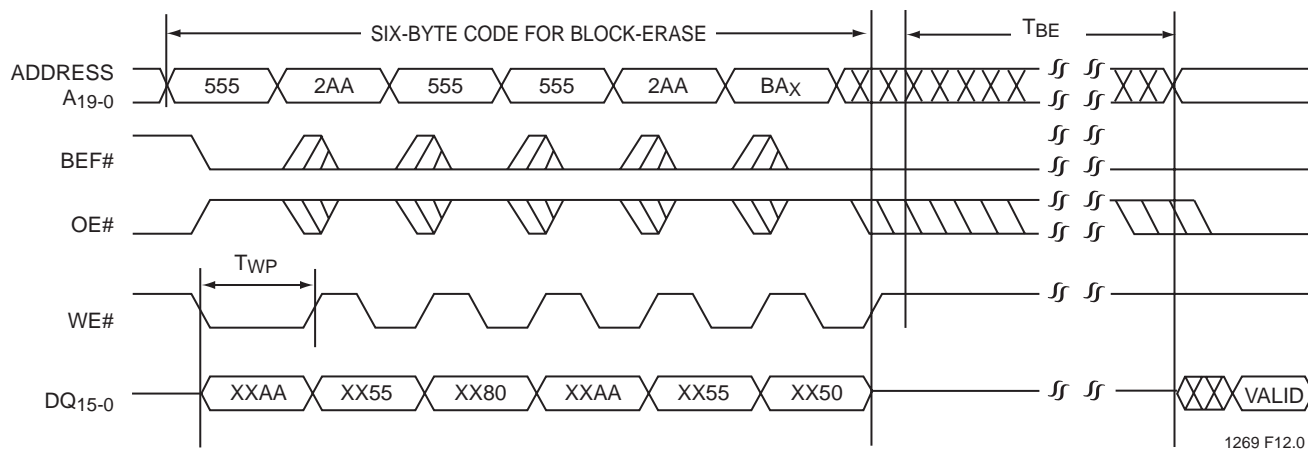
FIGURE 10: FLASH TOGGLE BIT TIMING DIAGRAM





**Note:** This device also supports BEF# controlled Chip-Erase operation.  
 The WE# and BEF# signals are interchangeable as long as minimum timings are met. (See Table 13.)  
 X can be  $V_{IL}$  or  $V_{IH}$ , but no other value.

**FIGURE 11: FLASH WE# CONTROLLED CHIP-ERASE TIMING DIAGRAM**



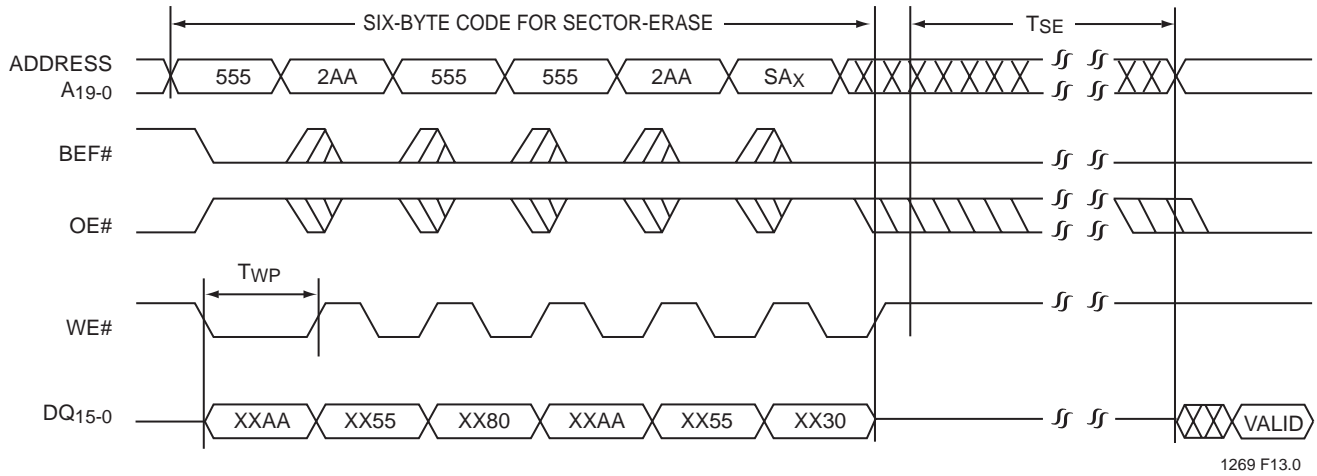
**Note:** This device also supports BEF# controlled Block-Erase operation.  
 The WE# and BEF# signals are interchangeable as long as minimum timings are met. (See Table 13.)  
 $BA_x$  = Block Address  
 X can be  $V_{IL}$  or  $V_{IH}$ , but no other value.

**FIGURE 12: FLASH WE# CONTROLLED BLOCK-ERASE TIMING DIAGRAM**



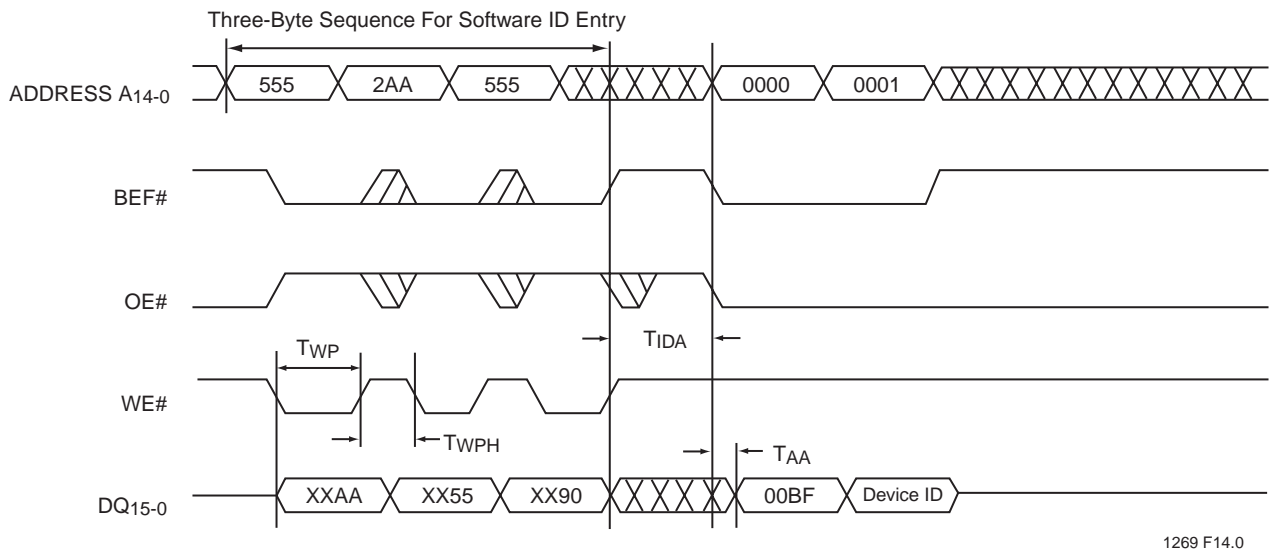
# 16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory SST34HF162C / SST34HF164C

Preliminary Specifications



**Note:** This device also supports BEF# controlled Sector-Erase operation.  
The WE# and BEF# signals are interchangeable as long as minimum timings are met. (See Table 13.)  
SA<sub>X</sub> = Sector Address  
X can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value.

**FIGURE 13: FLASH WE# CONTROLLED SECTOR-ERASE TIMING DIAGRAM**



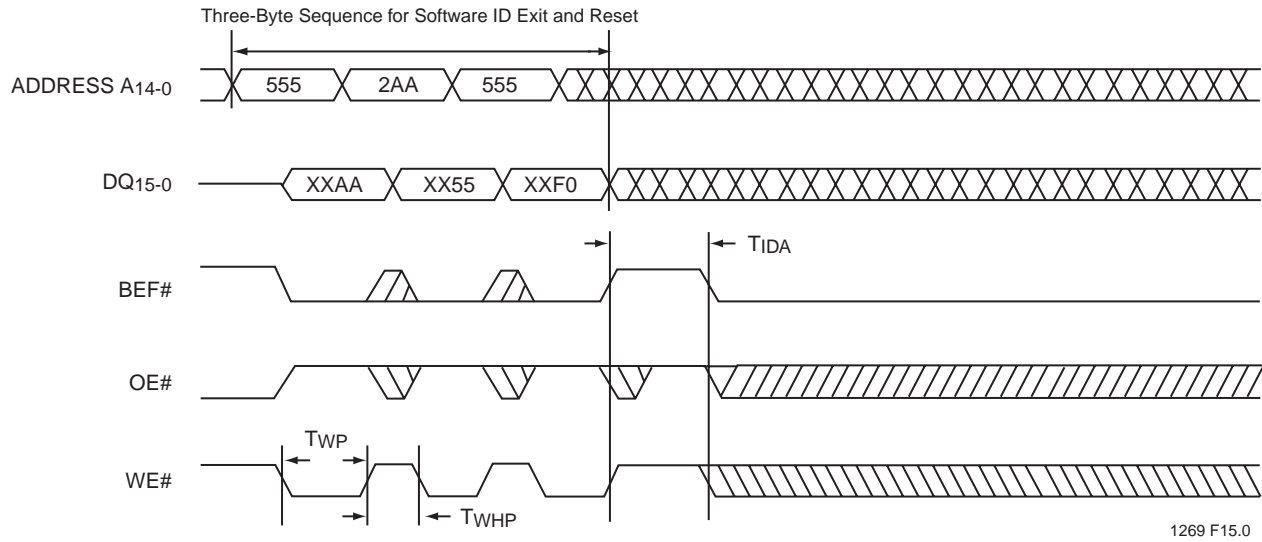
**Note:** X can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value.  
Device ID - 734BH for SST34HF162C/164C

**FIGURE 14: FLASH SOFTWARE ID ENTRY AND READ**

**16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory**  
**SST34HF162C / SST34HF164C**



Preliminary Specifications



**Note:** X can be  $V_{IL}$  or  $V_{IH}$ , but no other value

**FIGURE 15: FLASH SOFTWARE ID EXIT**



# 16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory SST34HF162C / SST34HF164C

Preliminary Specifications

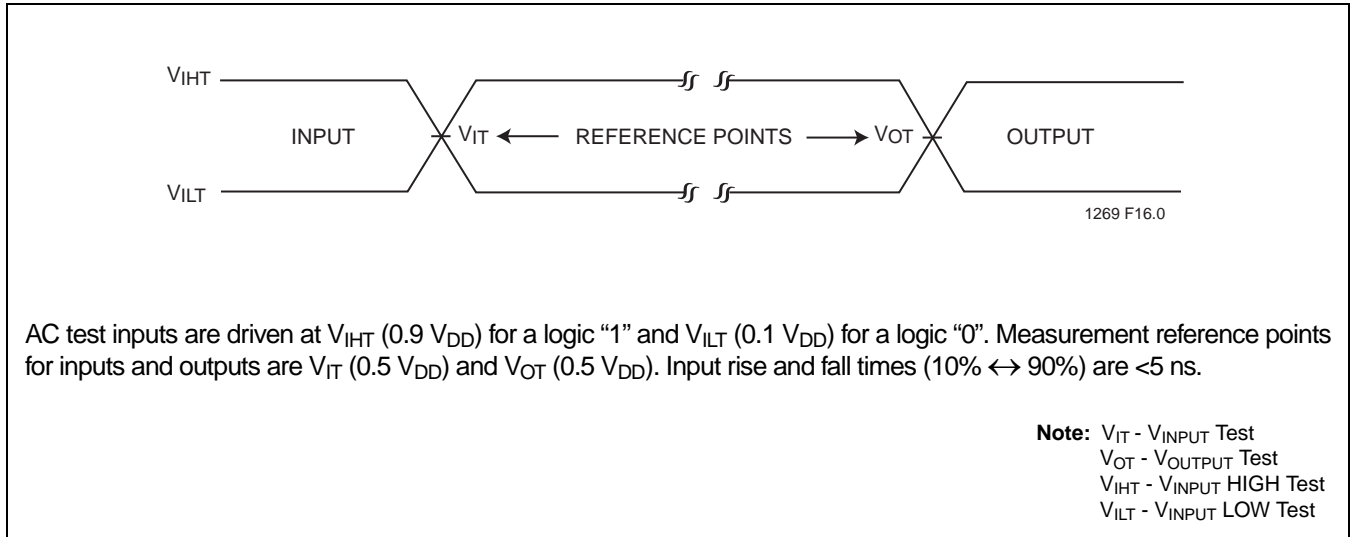


FIGURE 16: AC INPUT/OUTPUT REFERENCE WAVEFORMS

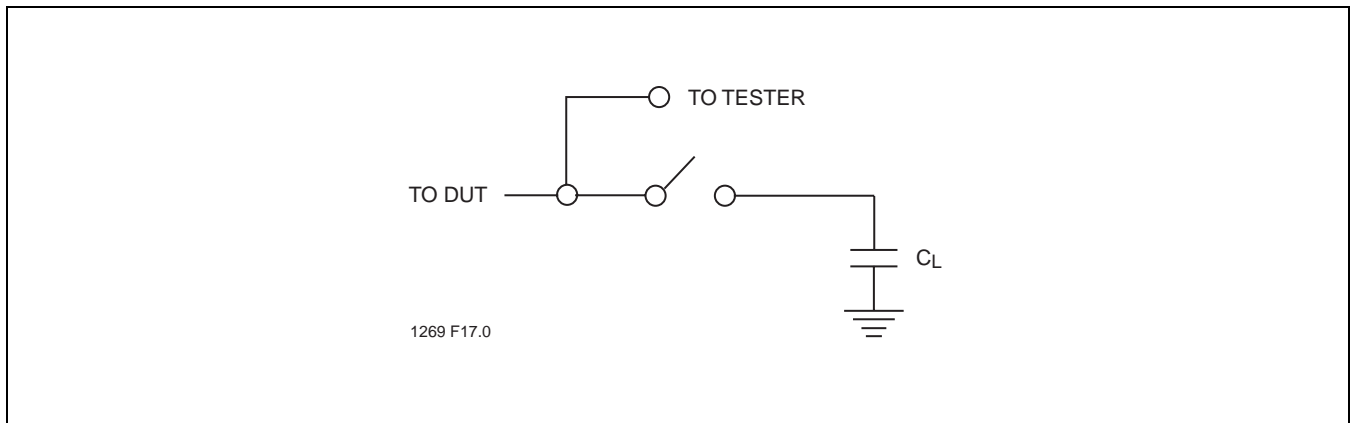


FIGURE 17: A TEST LOAD EXAMPLE

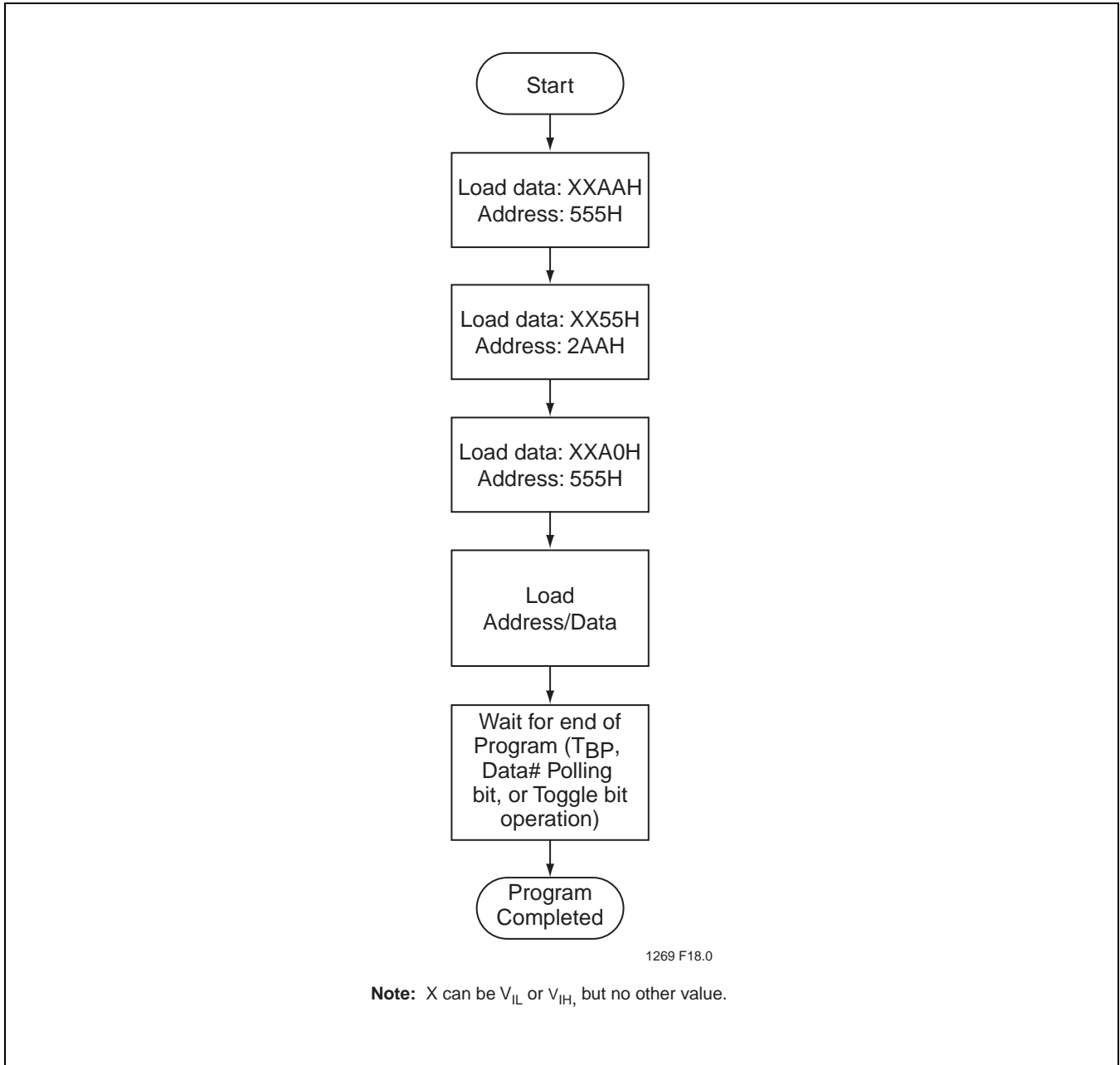


FIGURE 18: PROGRAM ALGORITHM

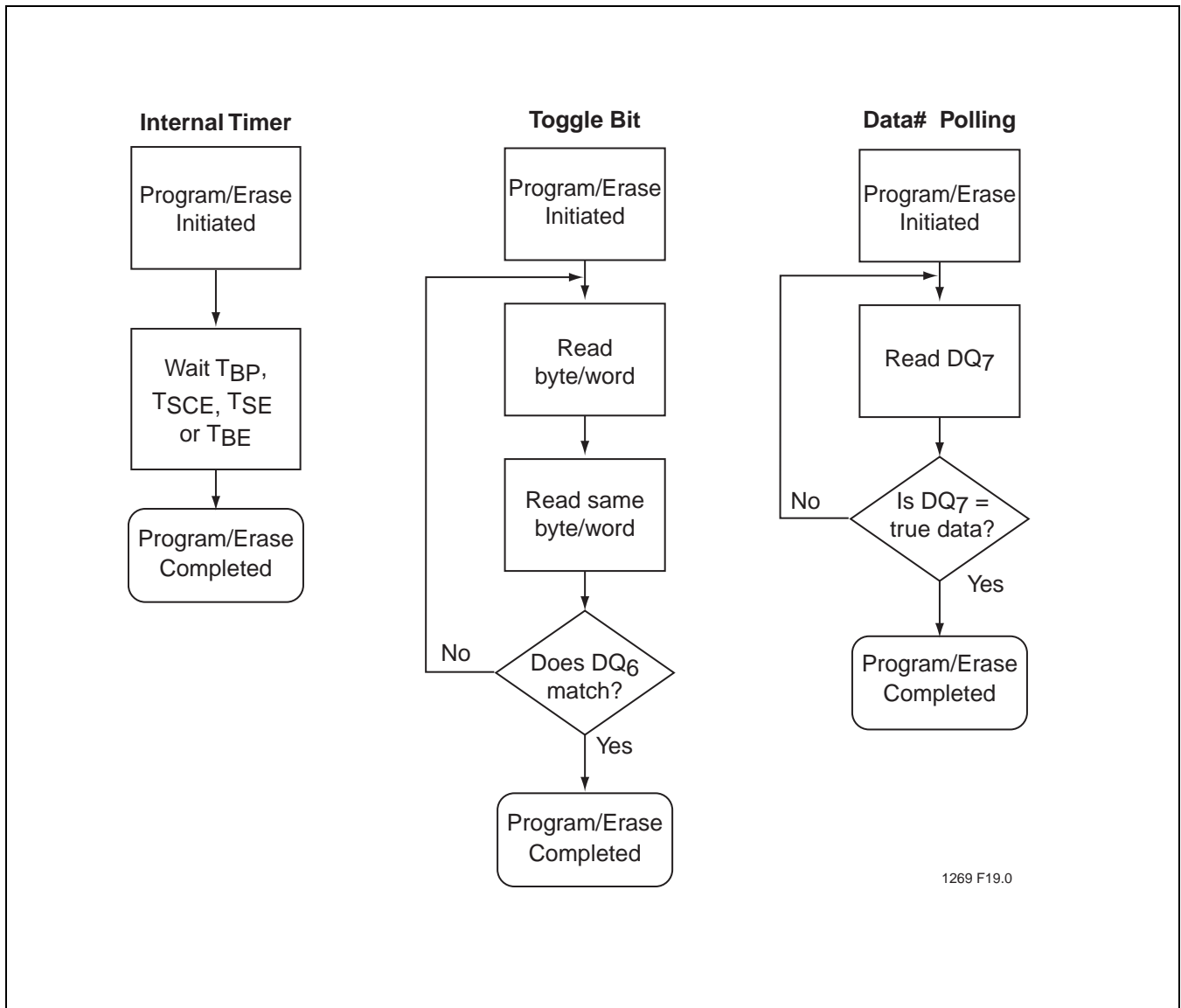
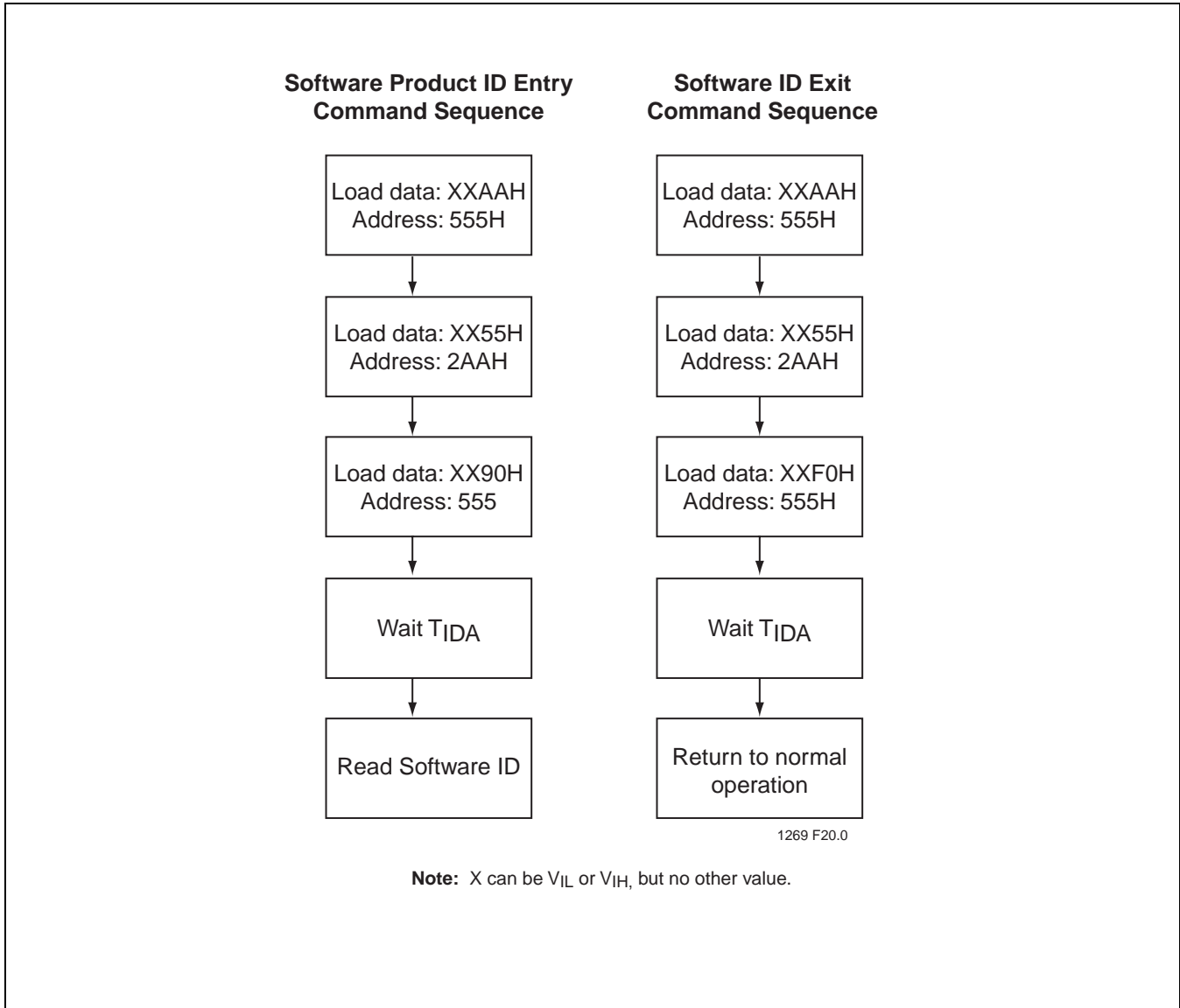


FIGURE 19: WAIT OPTIONS



**Note:** X can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value.

FIGURE 20: SOFTWARE PRODUCT ID COMMAND FLOWCHARTS

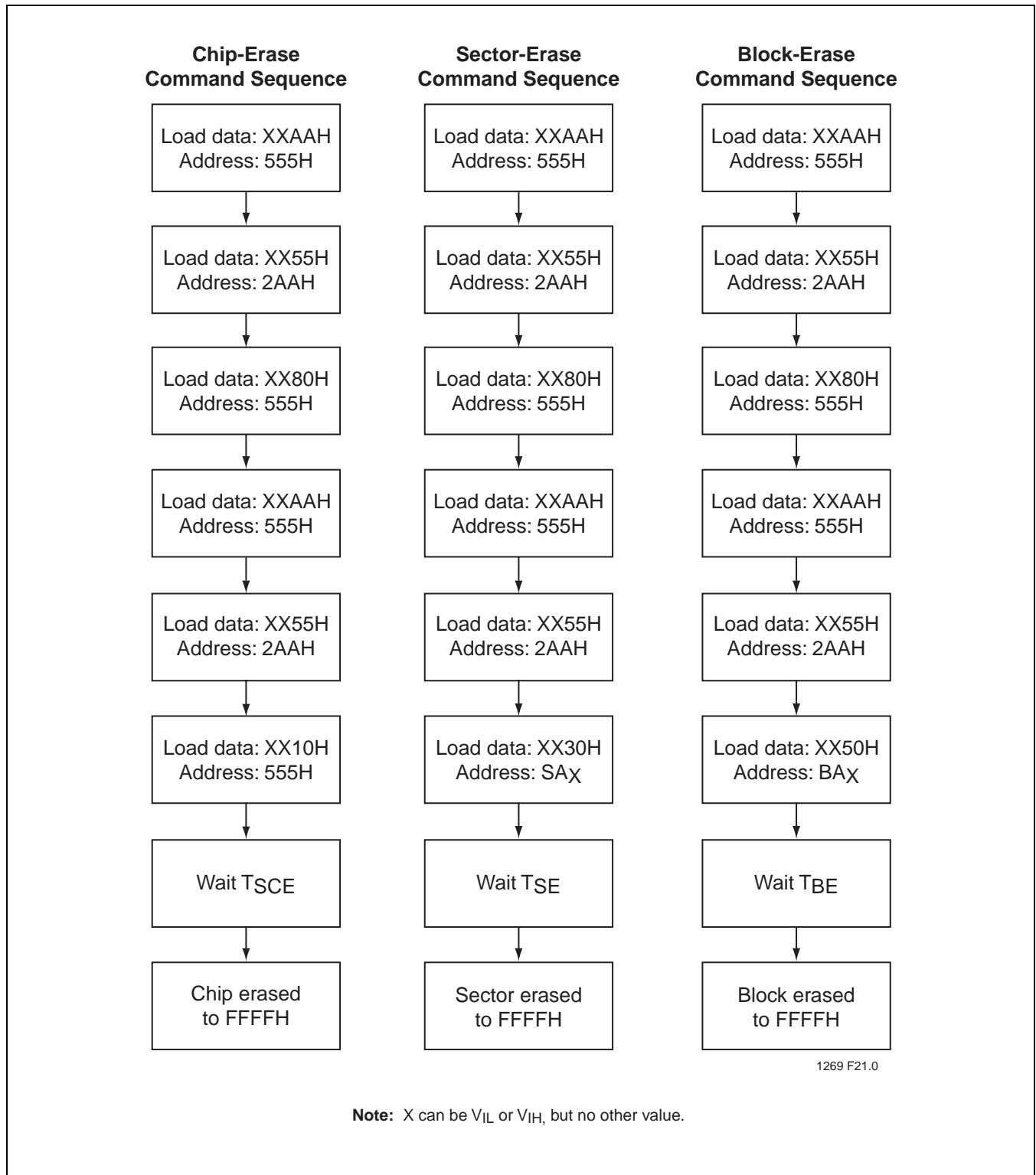


FIGURE 21: ERASE COMMAND SEQUENCE



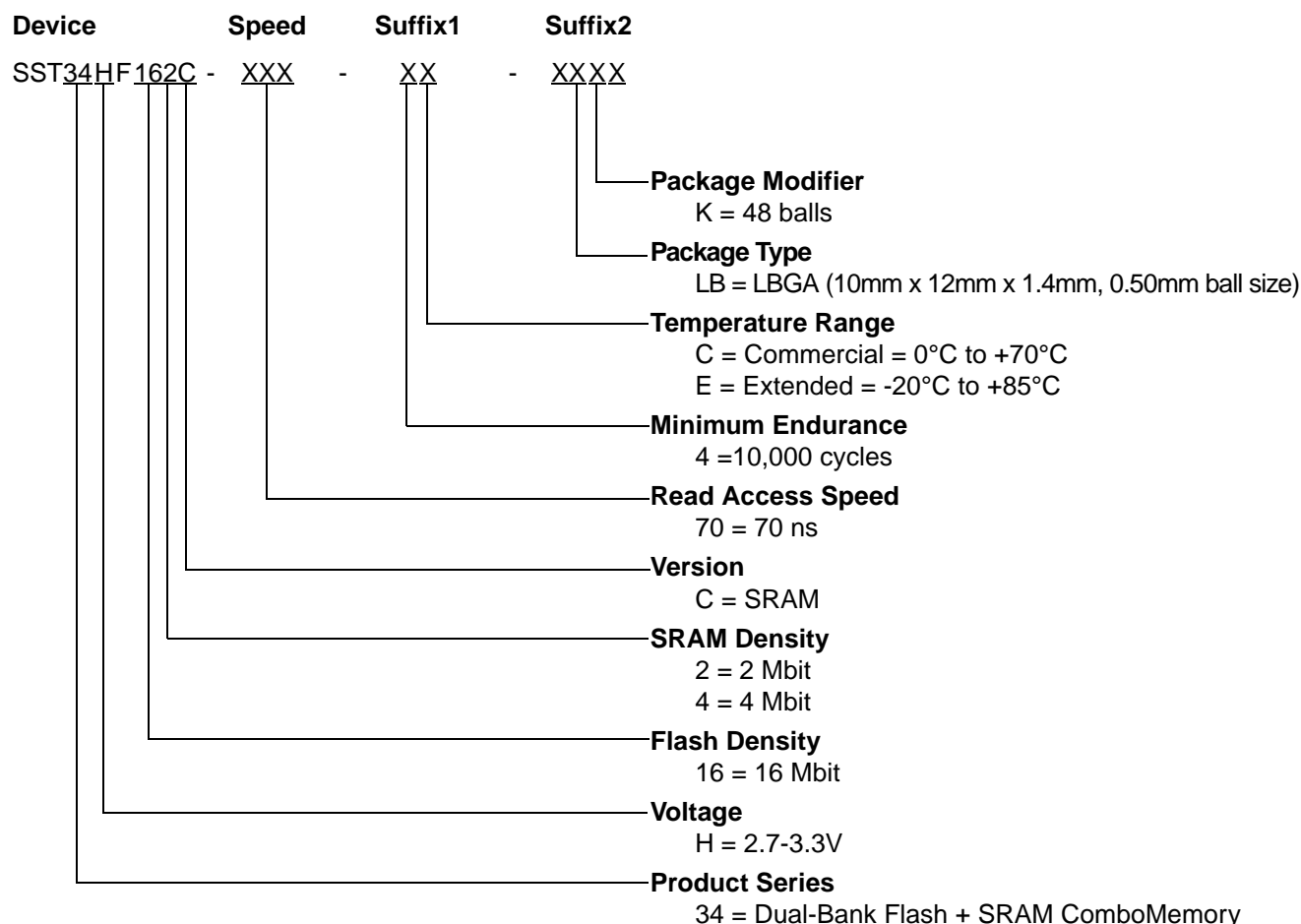


# 16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory

## SST34HF162C / SST34HF164C

Preliminary Specifications

### PRODUCT ORDERING INFORMATION



#### Valid combinations for SST34HF162C

SST34HF162C-70-4C-LBK  
SST34HF162C-70-4E-LBK

#### Valid combinations for SST34HF164C

SST34HF164C-70-4C-LBK  
SST34HF164C-70-4E-LBK

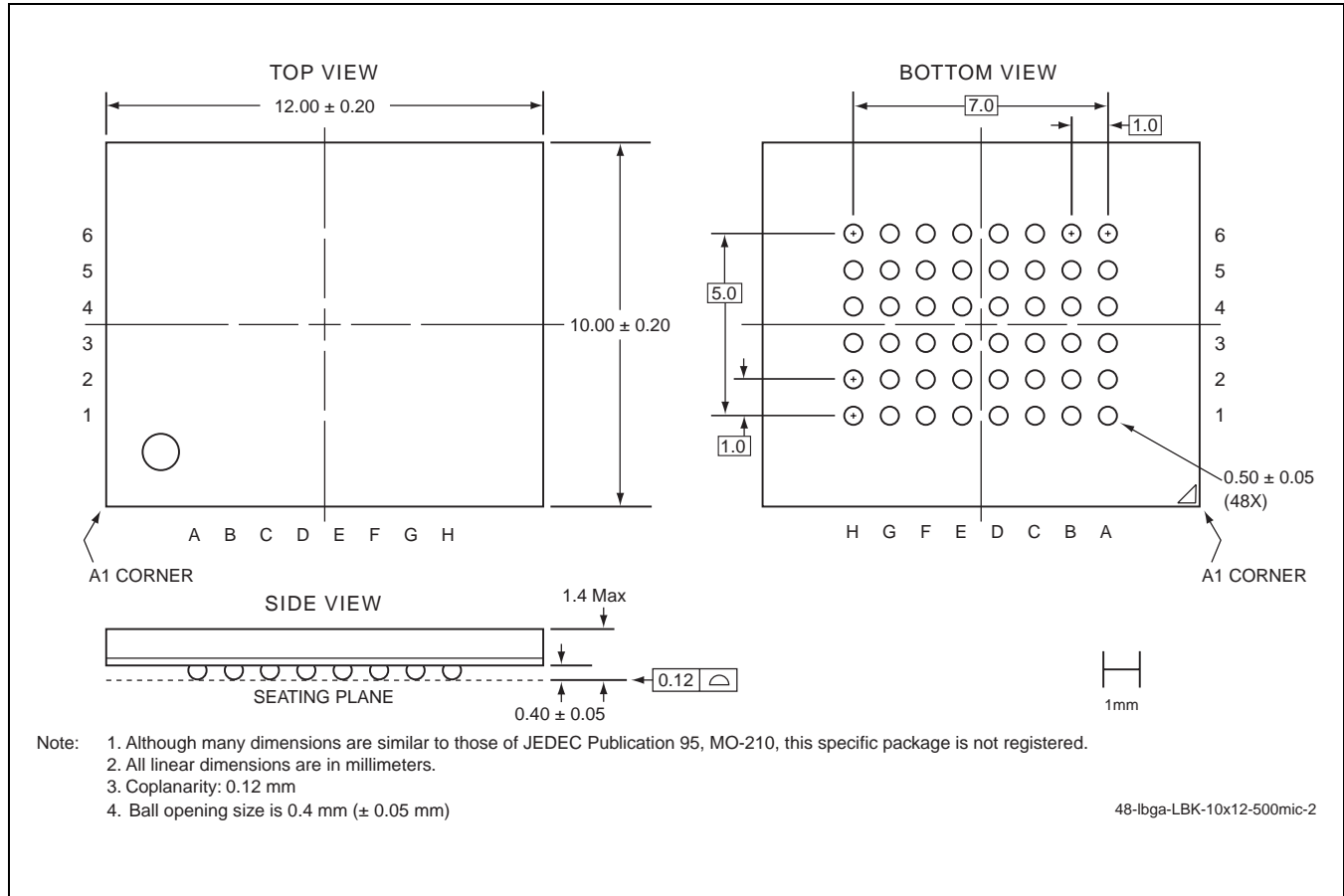
**Note:** Valid combinations are those products in mass production or will be in mass production. Consult your SST sales representative to confirm availability of valid combinations and to determine availability of new combinations.



# 16 Mbit Dual-Bank Flash + 2/4 Mbit SRAM ComboMemory SST34HF162C / SST34HF164C

Preliminary Specifications

## PACKAGING DIAGRAMS



**48-BALL LOW-PROFILE BALL GRID ARRAY (LBGA) 10MM X 12MM**  
**SST PACKAGE CODE: LBK**

**TABLE 14: REVISION HISTORY**

Number	Description	Date
00	• Initial Release	Aug 2004
01	• Adding 4 Mbit SRAM parts and associated MPNs • Removed PB-free MPNs for SST34HF162C devices • Clarified values for Low Power Consumption on page 1 • Added 5 MHz specifications for Active $V_{DD}$ Current ( $I_{DD}$ ) to Table 6 on page 10 • Data sheet status changed to "Preliminary Specifications"	Sep 2004